# Outline

- Logic
- Deduction and induction
- Classes of inductive questions (from philosophical induction to probability)
- Extreme resolutions: "Bayesian," "falsificationist," "conventionalist"

## Logic

As far as we know, among the great ancient civilizations, only the Greeks studied the formal validity of argumentation, a.k.a., logic (Shenefelt and White 2013). This presentation will borrow a lot from the lucid and readable reference Hacking 2001.

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Logic studies the *validity* of an argument, not the *truth* of its conclusions.

An argument is valid if it is logically sound.

A proposition is a statement which is either true or false.

**Example:**
If James wants a job, then he will get a haircut tomorrow.
James will get a haircut tomorrow.
So: James wants a job.

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**Questions:**
Which argument is valid?
What are the propositions?
Which propositions are true?

# Logic

**Which of these arguments are valid?** (Hacking 2001, Ch.1 Question 7)

- I follow three major league teams. Most of their top hitters chew tobacco at the plate.
  $\Rightarrow$ Chewing tobacco improves batting average.
- The top six hitters in the National League chew tobacco at the plate.
  $\Rightarrow$ Chewing tobacco improves batting average.
- A study by the American Dental Association of 158 players on seven major league teams during the 1988 season showed that the mean batting average for chewers was 0.238 compared to 0.248 for non-users. Abstainers also had a higher fielding average.
  $\Rightarrow$ Chewing tobacco does not improve batting average.
- In 1921, every major league pitcher who chewed tobacco when up to bat had a higher batting average than any major league pitcher who did not.
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**None of them are valid.**

But some are better than others. In what sense? In any logical sense?

# Logic

The Stoics identify the following syllogisms, purported patterns of valid inference:

- *Modus Ponens*: If A, then B. A. Therefore, B.
- *Modus Tollens*: If A, then B. Not B. Therefore, not A.
- The Hypothetical Syllogism: If A, then B. If B, then C. Therefore, if A, then C.
- The Conjunctive Syllogism: Not both A and B. A. Therefore, not B.
- The Dilemma: If A, then B. If C, then B. A or C. Therefore, B.
- The Disjunctive Syllogism: A or B. But not A. Therefore, B.

All logic consists of identifying rules like these which, when applied to true premises, guarantees true conclusions.

Humans are free to construct "logics," which may or may not actually produce something we are willing to call truth. To paraphrase Hacking 2016:

"The problem of the [logic] is to state a set of principles which entail the validity of all correct [inference], and which do not imply that any fallacious inference is valid."

# Example

Set theory can provide a means to visualize and analyze logical reasoning. Here is an example that I think may be useful.[1]

Suppose a bag contains three coins: one regular coin (HT), one with both faces tails (TT), and one with both faces heads (HH). The coin is flipped, and either the first or second side comes up.

Exactly one possible outcome of coin $\times$ side occurs; call this the "truth."

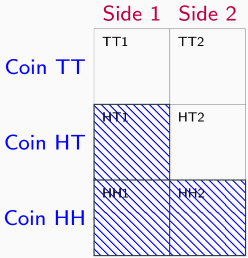
| | Side 1 | Side 2 |
|---|---|---|
| Coin TT | TT1 | TT2 |
| Coin HT | HT1 | HT2 |
| Coin HH | HH1 | HH2 × |

**Example:**
Coin HH was picked and the second side came up (HH2).

In this context, classical propositional logic can be represented as set operations.

[1] I cooked this up and have no idea how standard this is. I realized preparing for this how little I know about logic.

# Example

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## References


Hacking, I. (2001). *An introduction to probability and inductive logic*. Cambridge university press.

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Shenefelt, M. and H. White (2013). *If A, then B: How the world discovered logic*. Columbia University Press.